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NACOBBUS, THE FALSE ROOT-KNOT NEMATODE

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Nematodes in the genus Nacobbus produce galls that are similar in appearance to those caused by root-knot nematodes. If diagnosis is primarily based on field symptoms, it is often erroneously assumed that crop damage caused by Nacobbus species is due to Meloidogyne species. For this reason, Nacobbus species are referred to as false root-knot nematodes. The genus is named in honor of N. A. Cobb, (18) who published foundational contributions in plant nematology, and who, more than any other person, influenced the early development of this science in the United States.

Taxonomy: Two species of Nacobbus are recognized in Sher's revision of the genus in 1970 (14). These are N. aberrans (Thorne) Thorne and Allen and N. dorsalis Thorne and Allen. In Sher's revision, N. batatiformis Thorne and Schuster, N. serendipiticus Franklin, and N. serendipiticus bolivianus Lordello, Zamith, and Boock are synonymized with N. aberrans.

Diagnostic characteristics for survey and detection: Although Nacobbus and Meloidogyne species cannot be readily distinguished by symptoms they cause on host plants, these two genera are not difficult to distinguish in the laboratory when their morphologies are compared. Males, young females, and all juvenile stages of Nacobbus species are filiform (Fig. 1). The first and second stage juveniles and males of Meloidogyne species are also filiform, but third and fourth stage juveniles and young females are swollen or saccate. Mature Nacobbus females are fusiform and somewhat pointed at the posterior end of the body (Fig. 1C); mature Meloidodyne females are rounded at the posterior end. Meloidogyne females have two ovaries; Nacobbus females have one. Third and fourth stage Nacobbus juveniles are often coiled, giving them somewhat the general appearance of spiral nematodes (Fig. 1A).

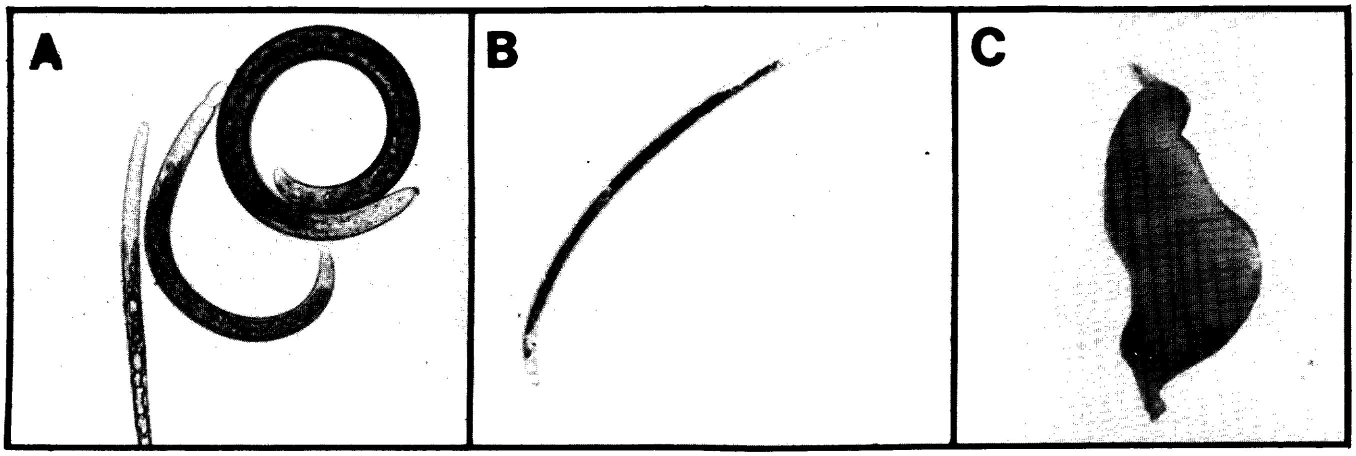

Fig. 1. Life stages of Nacobbus aberrans: A. 2nd, 3rd, and 4th stage juveniles; B. Immature female; C. Mature swollen female. (Photos courtesy of R. Inserra).

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LITERATURE CITED:

1. Amaya de Guerra, J., and A. C. Villanueva. 1981. Nacobbus aberrans causing damage to Capsicum in Trujillo, Peru. Rev. Peruana Ent. 23:169.
2. Brodie, B. B. 1984. Nematode parasites of potato. In: W. R. Nickle (ed.) Plant and insect nematodes. Marcel Dekker, Inc., New York. 925 pp.
3. Clark, S. A. 1967. The development and life history of the false root-knot nematode, Nacobbus serendipiticus. Nematologica 13:91-101.
4. Costilla, M. A. 1983. Advances and achievements of the studies on the false root-knot nematode Nacobbus aberrans in Argentina. OTAN News Letter, Organization of Tropical American Nematologists, (April 1983). Vol. 15(1):53.
5. Inserra, R. N., N. Vovlas, G. D. Griffin, and J. L. Anderson. 1983. Development of the false root-knot nematode, Nacobbus aberrans, on sugarbeet. J. Nematol. 15:288-296.
6. _____, G. D. Griffin, N. Vovlas, J. L. Anderson, and E. D. Kerr. 1984. Relationship between Heterodera schachtii, Meloidogyne hapla, and Nacobbus aberrans on sugarbeet. J. Nematol. 16:135-140.
7. Jatala, P., and R. Kaltenbach. 1979. Survival of Nacobbus aberrans in adverse conditions. (Abstr.). J. Nematol. 11:303.
8. _____, and M. M. De Scurrah. 1975. Mode of dissemination of Nacobbus spp. in certain potato-growing areas of Peru and Bolivia. (Abstr.). J. Nematol. 7:324-325.
9. Johnson, A. W., and G. Fassuliotis. 1984. Nematode parasites of vegetables. In: W. R. Nickle (ed.) Plant and insect nematodes. Marcel Dekker, Inc., New York. 925 pp.
10. Lordello, L. G. E., A. P. L. Zamith, and O. J. Boock. 1961. Two nematodes found attacking potato in Cochabamba, Bolivia. Ann. Acad. Brasil. Cienc. 33:209-215.
11. Prasad, S. K., and J. M. Webster. 1967. Effect of temperature on the rate of development of Nacobbus serendipiticus in excised tomato roots. Nematologica 3:85-90.
12. Schuster, M. L., R. Sandstedt, and L. W. Estes. 1965. Starch formation induced by plant parasitic nematode. Science 143:1342-1343.
13. _____, and G. Thorne. 1956. Distribution, relation to weeds, and histology of sugarbeet root galls caused by Nacobbus batatiformis Thorne and Schuster. J. Amer. Soc. Sugarbeet Technol. 9:193-197.
14. Sher, S. A. 1970. Revision of the genus Nacobbus Thorne and Allen, 1944. (Nematoda: Tylenchoidea). J. Nematol. 2:228-235.
15. Sosa Moss, C., and O. S. Gonzalez. 1973. Comportamiento de tres variedades de chile (Capsicum annuum) a cinco niveles de inoculo de Nacobbus serendipiticus (Nematoda-Nacobbidae). (Abstr.). Nematropica 3:14-16.
16. _____, and V. Munoz. 1973. Respuesta a dos variedades de tomate (Lycopersicon esculentum Mill.) a siete niveles de poblacion de Nacobbus serendipiticus (Nematoda: Nacobbidae). (Abstr.). Nematropica 3:16-17.
17. Thorne, G. 1935. The sugarbeet nematode and indigenous nemic parasites of shadscale. J. Agric. Res. 51:509-514.
18. _____, and M. W. Allen. 1944. Nacobbus dorsalis nov. gen. nov. spec. (Nematoda: Tylenchidae) producing galls on the roots of alfileria, Erodium cicutarium (L.) L'Her. Proc. Helminthol. Soc. Wash. 11:27-31.
19. _____, and M. L. Schuster. 1956. Nacobbus batatiformis n. sp. (Nematoda: Tylenchidae), producing galls on the roots of sugarbeet and other plants. Proc. Helminthol. Soc. Wash. 23:128-134.

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Some taxonomic literature related to the genus Nacobbus has illustrations in which Nacobbus, Heterodera, and Pratylenchus specimens were confused or labeled incorrectly (14,18). Nacobbus species, however, have a key characteristic which separates them from Pratylenchus and Heterodera species. The esophageal glands of Nacobbus species overlap the intestine on the dorsal side, whereas, the glands overlap ventrally in Pratylenchus and Heterodera. The dorsal overlap of the esophageal glands also distinguishes Nacobbus species from other common genera with swollen females, since in these genera the glands overlap the intestine on the ventral side.

Life cycle and histopathology: First stage juveniles of Nacobbus develop and molt within eggs that are laid in a gelatinous matrix outside the female's body. Embryogenic development is greatly affected by temperature. The duration of embryogenic development of N. aberrans was 9-10 days at 25 C, and 51 days at 15 C (5). Second stage juveniles hatch from the eggs (3,5). Second, third, and fourth stage juveniles, as well as young females (Fig. 2B), are capable of penetrating roots and, as they migrate and feed in the roots, they cause cavities that extend from the cortex into the stele (5). Maturing females become sedentary, and establish themselves with their heads near the vascular tissue, where they stimulate cell division, partial dissolution of cell walls, and fusion of cell protoplasts. A spindle-shaped synctium is formed, and these specialized cells with dense cytoplasm become the feeding site for the female. Around this feeding site a gall is formed by proliferation of cortical and vascular tissue (3,5,13,19). Numerous starch granules accumulate at the feeding site (12). Galls tend to be rounded or bead-like and sometimes numerous small rootlets develop around the galls (Fig. 2B and 2C). The time required for N. aberrans to complete a life cycle is primarily temperature dependent, but also may be influenced by the nematode population and host species. On tomato, the life cycle was completed in 36 days at 25 C, and 43 days at 20 or 30 C (11). Another population of N. aberrans required 48 days to complete its life cycle on sugarbeet at 25 C (5).

Distribution and principal hosts: In 1935, Thorne described the first species of Nacobbus from specimens he observed parasitizing Atriplex confertifolia (Torr. and Frem.) S. Wats., a native shrub known as shadscale, that he collected in the desert foothills near Utah Lake, Utah (17). Since that time, Nacobbus aberrans has been reported on many important crop plants in Argentina, Bolivia, Chile, Ecuador, Great Britain, India, Mexico, Netherlands, Peru, United States, and the U.S.S.R.

In the United States, Nacobbus species are parasites of sugarbeet. Nacobbus aberrans is frequently found on sugarbeet with other nematodes such as Meloidogyne hapla Chitwood and Heterodera schachtii Schmidt. Because of its long life cycle and the limited fecundity of females, N. aberrans is considered to be less aggressive on sugarbeet than the sugarbeet cyst nematode, H. schachtii or the root-knot nematode, M. hapla (6). Nevertheless, with high populations of the false root-knot nematode, the sugarbeet storage root is distorted and deformed, and the top growth of this plant is greatly reduced (6). Surveys in the early 1950's indicated approximately one-third of the sugarbeet fields in western Nebraska were infested with N. aberrans (19). This nematode has also been found on sugarbeet in limited areas in Colorado, Kansas, Montana, South Dakota, and Wyoming. The other species of false root-knot nematode, N. dorsalis, has been reported to cause severe losses to sugarbeet only in California (14). Nacobbus aberrans has also been found in southern Texas on spinach, Spinacia oleracea L., (personal communication, R. N. Inserra).

In South America, in the highlands of Argentina, Bolivia, Chile, Ecuador, and Peru, N. aberrans is a serious problem on potato, Solanum tuberosum L., and in some of these countries it is an important pathogen of tomato, Lycopersicon esculentum Mill., and pepper, Capsicum sp. (1,2,4,7,8,10). In many parts of Mexico, in addition to causing a problem on tomato and pepper, N. aberrans is also a problem on bean, Phaseolus vulgaris L., and Amaranthus sp. (9,15,16). Other vegetables that are

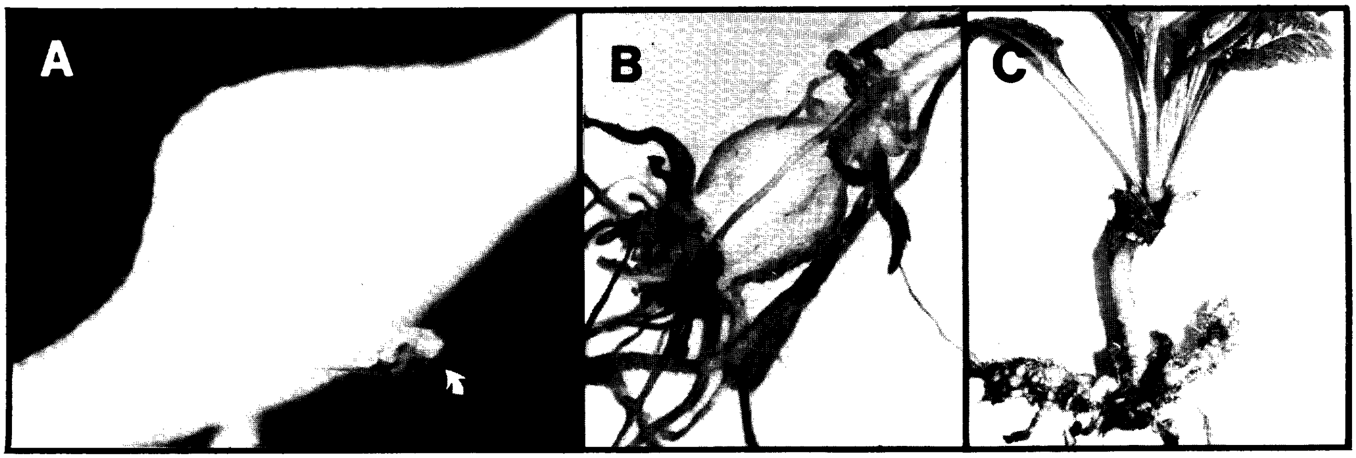

Fig. 2. Symptoms induced by Nacobbus aberrans in sugarbeet (Beta vulgaris) cv. Tasco AH14 roots: A. Gall with swollen female in semi-endoparasitic position; B. Gall with abnormal lateral root proliferation induced by N. aberrans; C. Deformed sugarbeet root system severely galled by N. aberrans. (Photos courtesy of R. Inserra).

hosts of N. aberrans include broccoli, brussels sprouts, cabbage, carrot, cucumber, eggplant, kale, lettuce, pumpkin, pea, radish, rutabaga, spinach, and turnips (4,9,19). Populations of N. aberrans may also increase and survive on some weed hosts. Examples of very good weed hosts are Chenopodium album L. and Kochia scoparia Schrad. (4,19). Most legume and cereal crops, however, are very poor hosts or nonhosts of N. aberrans (19).

Regulatory Considerations: Nacobbus species are known to occur in the western United States but not in the the eastern states. The fact that certain populations of N. aberrans have quite different host ranges suggests that there are pathotypes or physiological races of this nematode. Nacobbus aberrans populations, which parasitize sugarbeet populations in the western United States, do not parasitize potato, whereas, many populations from South America are capable of parasitizing potato and sugarbeet. Where high infestations of N. aberrans occur in South America, potato yield losses of 55% to 90% have been reported (2).

Juveniles and immature females may invade potato tubers (8). Normally, they are found in the first few millimeters below the epidermis and do not cause galls, lesions, or other symptoms on the tubers. Because these nematodes may be disseminated with infected tubers, tuber shipments from known infested areas into disease-free areas should be prevented whenever possible.

Populations of Nacobbus aberrans which parasitize potato in South America are known to have a rather wide host range, and are adapted to a variety of soil types. Some of these populations are known to survive in adverse conditions. In laboratory experiments, N. aberrans survived for 8 months in air-dried soil with relative soil humidity varying from 7 to 9%. Juveniles and immature females survived in infected roots and infested soil for 4 months at -13 C (7). The ability of South American populations to adapt to many hosts and diverse conditions increases the risk of these populations becoming established, should they be introduced into noninfested areas. Special efforts should be made to prevent populations of N. aberrans that parasitize potatoes from entering the United States.